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Article 34 Amendment

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AMENDMENT

(pursuant to Article 11 of the Japanese Patent Law)

To: Hiroaki Hirai, Patent Office Examiner

1. International Application Classification: PCT/JP2004/004501

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4. Object of the Amendment:

Specification and Claims

5. Content of the Amendment

The specification and claims have been corrected as per the attached sheet. Specifically:

(1) The text "..., a mean fiber size of 0.1-20 μm ,..." on page 5, line 4 of the specification is corrected to "..., a mean fiber size of 0.1-5 μm ,..."

(2) The text "The nonwoven fabric of the invention ... having a mean fiber size of 0.1-20 μm ,..." on page 5, line 10 of the specification is corrected to "The nonwoven fabric of the invention ... having a mean fiber size of 0.1-5 μm ,..."

(3) The text "The mean fiber size is also preferably not greater than 20 μm because the cell-adhering area will be too small. More preferably, the mean fiber size is 0.1-5 μm , and even more preferably the mean fiber size is 0.1-4 μm ." on page 5, lines 13-16

of the specification is corrected to "The mean fiber size is also preferably not greater than 5 μm because the cell-adhering area will be too small. More preferably, the mean fiber size is 0.1-4 μm ."

(4) The text "..., a mean fiber size of 0.1-20 μm ,..." on page 9, line 10 of the specification is corrected to "..., "..., a mean fiber size of 0.1-5 μm ,..."

(5) The text "A nonwoven fabric characterized by being an aggregate of filaments composed of a thermoplastic polymer, and by having a mean fiber size of 0.1-20 μm , wherein any given lateral cross-section of the filaments is an irregular shape, and a mean apparent density in the range of 10-95 kg/m³." in the Claims, page 19, claim 1 is corrected to "A nonwoven fabric characterized by being an aggregate of filaments composed of a thermoplastic polymer, and by having a mean fiber size of 0.1-5 μm , wherein any given lateral cross-section of the filaments is an irregular shape, and a mean apparent density in the range of 10-95 kg/m³."

(6) Claim 3 on page 19 of the Claims is deleted.

(7) The text "A process for production of a nonwoven fabric, which comprises a step wherein a thermoplastic polymer is dissolved in a mixed solvent composed of a volatile good solvent and a volatile poor solvent, a step wherein the resulting solution is spun by an electrospinning method and a step wherein a nonwoven fabric accumulated on a collecting sheet is obtained, which process yields a nonwoven fabric with a mean fiber size of 0.1-20 μm , wherein any given lateral cross-section of said filaments is irregular, and a mean apparent density in the range of 10-95 kg/m³." in the Claims, page 20, claim 13 is corrected to "A process for production of a nonwoven fabric, which comprises a step wherein a thermoplastic polymer is dissolved in a mixed solvent composed of a volatile good solvent and a volatile poor solvent, a step wherein the resulting solution is spun by an electrospinning method and a step wherein a nonwoven fabric accumulated on a collecting sheet is obtained,

which process yields a nonwoven fabric with a mean fiber size of 0.1-5 μm , wherein any given lateral cross-section of said filaments is irregular, and a mean apparent density in the range of 10-95 kg/m³."

6. List of Attached Documents

- (1) Specification, substitute pages 5 and 9
- (2) Claims, pages 19 and 20

magnification) of the surface of a fiber structure obtained by the procedure of Example 7.

Fig. 22 is an electron microscope photograph (20,000 \times magnification) of the surface of a fiber structure obtained by the procedure of Example 7.

Best Mode for Carrying Out the Invention

The present invention will now be explained in greater detail.

The nonwoven fabric of the invention is an aggregate of filaments composed of a thermoplastic polymer, and it is characterized by having a mean fiber size of 0.1-5 μm , wherein any given lateral cross-section of the filaments is irregular, and a mean apparent density in the range of 10-95 kg/m^3 .

According to the invention, a nonwoven fabric is a three-dimensional structure formed by laminating single or multiple filaments and partially anchoring them by interweaving the filaments if necessary.

The nonwoven fabric of the invention consists of an aggregate of filaments having a mean fiber size of 0.1-5 μm , wherein any given lateral cross-section of the filaments is irregular.

The mean fiber size is preferably not less than 0.1 μm because the biodegradability will be too rapid when the fabric is used as a matrix for cell culturing for the purpose of regenerative medicine. The mean fiber size is also preferably not greater than 5 μm because the cell-adhering area will be too small. More preferably, the mean fiber size is 0.1-4 μm .

According to the invention, the fiber size is the diameter of the lateral cross-section of the filament, and in the case of an elliptical filament cross-sectional shape, the fiber size is calculated as the average between the length in the long axis direction and the length in the short axis

invention is not restricted and may be rectangular, circular, cylindrical or the like, secondary processing of the nonwoven fabric, such as lamination with other sheet materials or processing into a mesh form, will be facilitated from the standpoint of handleability if the thickness of the nonwoven fabric is at least 100 μm , while thicker structures can be formed by stacking nonwoven fabrics together.

The process for producing the nonwoven fabric of the invention may be any method which yields a nonwoven fabric satisfying the conditions described above, and is otherwise not particularly restricted. For example, after obtaining the filament by a melt spinning method, dry spinning method or wet spinning method, the obtained filament may be subjected to a spun bond method, a melt blow method or an electrospinning method for production. Production by electrospinning is preferred. A production process by electrospinning will now be explained in detail.

The production process of the invention comprises a step wherein the thermoplastic polymer is dissolved in a mixed solvent composed of a volatile good solvent and a volatile poor solvent, a step wherein the resulting solution is spun by an electrospinning method and a step wherein a nonwoven fabric accumulated on a collecting sheet is obtained, and the process yields a nonwoven fabric with a mean fiber size of 0.1-5 μm , wherein any given lateral cross-section of the filaments is irregular, and a mean apparent density in the range of 10-95 kg/m³.

In other words, the nonwoven fabric of the invention may be obtained as an aggregate of a fiber substance formed by discharging a solution of the thermoplastic polymer in a mixed solvent composed of a volatile good solvent and a volatile poor solvent into an electrostatic field formed between electrodes, and attracting the solution toward the electrodes.

The concentration of the thermoplastic polymer in the solution used for the production process of the invention is

CLAIMS

1. (Corrected) A nonwoven fabric characterized by being an aggregate of filaments composed of a thermoplastic polymer, and by having a mean fiber size of 0.1-5 µm, wherein any given lateral cross-section of the filaments is an irregular shape, and a mean apparent density in the range of 10-95 kg/m³.

2. A nonwoven fabric according to claim 1, wherein said irregular shape is at least one type selected from the group consisting of fine pits on the filament surfaces, fine protrusions on the filament surfaces, pits formed in a linear fashion in the fiber axis direction on the filament surfaces, protrusions formed in a linear fashion in the fiber axis direction on the filament surfaces and micropores in the filament surfaces.

3. (Deleted)

4. A nonwoven fabric according to claim 1, wherein the nonwoven fabric thickness is 100 µm or greater.

5. A nonwoven fabric according to claim 1, wherein the thermoplastic polymer is a polymer which is soluble in a volatile solvent.

6. A nonwoven fabric according to claim 5, wherein the thermoplastic polymer which is soluble in a volatile solvent is an aliphatic polyester.

7. A nonwoven fabric according to claim 6, wherein the aliphatic polyester is polylactic acid.

8. A nonwoven fabric according to claim 5, wherein the volatile solvent is a mixed solvent comprising a volatile good solvent and a volatile poor solvent.

9. A nonwoven fabric according to claim 8, wherein the ratio of the volatile poor solvent and volatile good solvent in said mixed solvent is in the range of (23:77) to (40:60), based on weight.

10. A nonwoven fabric according to claim 8, wherein the volatile good solvent is a halogen-containing hydrocarbon.

11. A nonwoven fabric according to claim 8, wherein the volatile poor solvent is a lower alcohol.

12. A nonwoven fabric according to claim 11, wherein the lower alcohol is ethanol.

13. (Corrected) A process for production of a nonwoven fabric, which comprises a step wherein a thermoplastic polymer is dissolved in a mixed solvent composed of a volatile good solvent and a volatile poor solvent, a step wherein the resulting solution is spun by an electrospinning method and a step wherein a nonwoven fabric accumulated on a collecting sheet is obtained, which process yields a nonwoven fabric with a mean fiber size of 0.1-5 µm, wherein any given lateral cross-section of said filaments is irregular, and a mean apparent density in the range of 10-95 kg/m³.

14. A process for production of a nonwoven fabric according to claim 13, wherein the ratio of the volatile poor solvent and volatile good solvent in said mixed solvent is in the range of (23:77) to (40:60), based on weight.

15. A process for production of a nonwoven fabric according to claim 13, wherein the volatile good solvent is a halogen-containing hydrocarbon.

16. A process for production of a nonwoven fabric according to claim 13, wherein the volatile poor solvent is a lower alcohol.

17. A process for production of a nonwoven fabric according to claim 16, wherein the lower alcohol is ethanol.